PB88-126461

Superfund Record of Decision (EPA Region 8)
Denver Radium/Card Corporation Property
Colorado (Third Remedial Action), June 1987

(U.S.) Environmental Protection Agency
Washington, DC

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EPA/ROD/R08-87/012
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EPA

Superfund Record of Decision:

DENVER RADIUM/ CARD PROPERTY, CO

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16. ABSTRACT

The Denver Radium/Card Corporation property is a 17.2-acre site located in Denver, Colorado. In 1979, the EPA discovered a reference to the National Radium Institute in a 1916 U.S. Bureau of Mines report. Subsequent field research revealed the presence of thirty-one radioactive sites in the Denver Metropolitan area, one of these being Card property, the location of the original Pittsburgh Radium Company processing facility. The site consists of five buildings and an oil and waste water pond at the eastern boundary. There is no serious public health risk at present from radium or its decay products, most notable radon gas. However, there is the potential for increased public health risk if the radium contaminated materials are misused or inadvertently spread. Currently, radium has been detected in the soil, sediment and underneath the True Truss building.

EPA's preferred remedial action for the Card property is permanent offsite disposal. However, this alternative can not be implemented until a suitable offsite facility is designated. In the interim, the selected remedy is temporary onsite building storage. This includes: excavation of approximately 4,000 cubic yards of radium-contaminated soil and sediment; storage of the contaminated material within reinforced synthetic bags placed within the True Truss building and within possible additions to the building; optional staging or storage of contaminated material from selected other Denver Radium

(See Attached Sheet)

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Record of Decision Denver Radium/Card Property, Co. Contaminated Media: sediment, soil, debris, (building) Key contaminants: radium	None	34

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EPA/ROD/R08-87/012
Denver Radium/Card Property, Co.
Third Remedial Action

16. ABSTRACT (continued)

site properties on the Card property; final offsite disposal of all contaminated material to a facility suitable for the permanent waste disposal; and decontamination and dismantling of True Truss building and any additions with disposal of the material in a sanitary landfill. The present worth cost for the selected remedy is $1,148,000 with present worth O&M costs of $89,500.

Declaration
for the
Record of Decision

Site Name

Card Corporation Property
Operable Unit X
Denver Radium Site

Site Location

1314 West Evans Avenue
Denver, Colorado

Statement of Purpose

This decision document presents the selected remedial action for this operable unit of the Denver Radium Site developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the National Contingency Plan (40 CFR Part 300).

The State of Colorado has concurred on the selected remedy.

Statement of Basis

This decision is based upon the administrative record for the Denver Radium Site. The attached index identifies the items which comprise the administrative record upon which the selection of the remedial action was based.

Description of Selected Remedy

This operable unit of the Denver Radium Site addresses the contamination present on the Card Corporation property ("Card property"). The hazardous substances of primary concern that have been released and continue to pose a significant threat of being released into the environment are radium and its associated decay products.

EPA's preferred remedial action alternative for the Card property is Permanent Offsite Disposal. However, until a facility suitable for permanent disposal of the Card property material is designated and, if necessary, acquired and developed, this alternative cannot be implemented. Pursuant to CERCLA Section 104(c)(3)(C)(ii), it is the responsibility of the State of Colorado to assure the availability of the disposal facilities for offsite

disposal of the Card property material. Although both the EPA and the State of Colorado are continuing to seek a permanent disposal site, the State predicts that this process could take up to five years. In order to prevent or minimize the threat to public health, welfare, and the environment, given the length of time until permanent offsite disposal of the material can be implemented, the EPA determined that a remedial action alternative which includes a temporary response action should be implemented at the Card property.

The selected remedy for the Card property is Temporary Onsite Building Storage/Permanent Offsite Disposal. This alternative will attain a degree of cleanup of the hazardous substances which will assure protection of human health and the environment. This remedial action alternative entails:

- excavation of approximately 4,000 cubic yards of radium-contaminated soil and sediment from the Card property;

- storage of the contaminated material within reinforced synthetic bags placed within the True Truss building and within possible additions to the building;

- optional staging or storage of contaminated material from selected other Denver Radium Site properties on the Card property - the total amount of material to be staged or stored on the Card property not to exceed 13,000 cubic yards including the contaminated material already present on the Card property;

- final removal of all contaminated material to a facility suitable for the permanent disposal of Denver Radium Site wastes; and

- decontamination and dismantling of True Truss building and any additions and disposal of the material in a sanitary landfill.

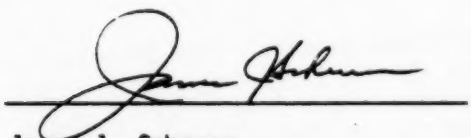
The present worth cost of the selected remedy is $1,148,000 assuming a discount period of five years and a discount rate of 10%. The cost includes excavation of all contaminated material, placement of the material in reinforced synthetic bags, placement of the bags in the True Truss building, and maintenance and monitoring of the bags and building for 5 years. The cost also includes removal and transportation of the contaminated material to an offsite disposal facility, as well as dismantling and decontaminating the building and transporting the building material to a sanitary landfill.

Operation and maintenance activities will be required to ensure the effectiveness of the temporary storage facility. The maximum total of discounted annual operation and maintenance costs, using a discount period of five years and a discount rate of 10%, is $89,500. Operation and maintenance activities include site inspections and possible minor structural repairs to the temporary storage facility. These activities will be considered part of the approved remedy and will be eligible for Trust Fund monies for the entire period that the temporary storage facility is operational. The State of Colorado will share responsibility for all operation and maintenance costs of the temporary facility in the same manner as other aspects of remedial action.

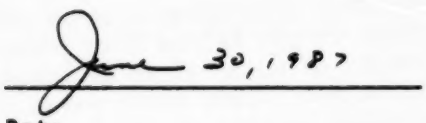
The EPA is undertaking additional feasibility studies to evaluate remedial action alternatives at the other Denver Radium Site Operable Units and will complete a Record of Decision or an Action Memorandum for each of the Operable Units for which a remedy has not already been selected.

Declarations

Consistent with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Contingency Plan (40 CFR Part 300), I have determined that the selected remedy for the Card property described in the preceding section is protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate, and is cost-effective. This remedy does not satisfy the statuatory preference for treatment which reduces the toxicity, mobility, and volume of hazardous substances as its principal element because treatment was determined to be impracticable based upon technical feasibility, implementability, and cost.



James J. Scherer
Regional Administrator
EPA Region VIII



Date

Summary of Remedial Alternative Selection

Site Name

Card Corporation
Operable Unit X
Denver Radium Site

Site History

What is known today as the Denver Radium Site has its roots in the robust U.S. radium producing industry of the early 1900's. At that time, radium was considered to be a wonder drug, a cure-all for every ailment from the common cold to cancer. A mere gram of the radioactive element sold for $325,000.

Prior to 1914, there was no U.S. production of radium. Rather, radium-bearing ore was shipped from the U.S. to Europe where it was refined. Fearing that a European war might stymie U.S. importation of radium, the U.S. Bureau of Mines entered into a cooperative agreement with a private corporation, the National Radium Institute, to develop and operate a radium processing plant in the United States.

Denver was the chosen location for the Institute due to its proximity to carnotite, a radium-bearing ore of the Colorado Plateau. Soon there were at least eight other radium processing operations in Denver. One of those radium producers was Pittsburgh Radium Company. Using equipment purchased from the Institute, Pittsburgh Radium Company began operations in 1920 in what had been the Overland Cotton Mill building.

The Denver radium industry remained strong until around 1920 when extremely rich deposits of the radium-bearing ore, pitchblende, began to be developed in the Belgian Congo. Most Denver radium producers were not able to compete with their African counterparts and were forced out of business. The Pittsburgh Radium Company was one producer which was able to continue operations because, unlike the other radium producers who processed carnotite for radium, Pittsburgh Radium Company processed roscoelite for vanadium. However, Pittsburgh Radium Company, too, was eventually forced to close. Records show that the company sold the Overland Cotton Mill building in 1924.

Since 1924, the property has had various industrial uses including World War II and Korean War munitions manufacturing, hardware manufacturing, and fabrication of heavy mining equipment. The property became known as the Card property because Card Corporation owned the property in 1979, when the radiological contamination was discovered there. The property will be referred to throughout the remainder of this summary as the Card property.

Response History

In 1979, the EPA discovered a reference to the National Radium Institute in a 1916 U.S. Bureau of Mines report. Subsequent field research revealed the presence of thirty-one radioactive sites in the Denver metropolitan area, one of these being the Card property, the location of the original Pittsburgh Radium Company processing facility (Figure 1). Immediately following these discoveries, the Radiation Control Division of the Colorado Department of Health officially notified the affected property owners of the presence of contamination on their properties. The letters requested that no excavation or soil movement be undertaken without first contacting the Division.

The Denver Radium Site was placed on the Interim Priorities List in October, 1981, and final promulgation of the National Priorities List occurred on September 8, 1983. The Colorado Department of Health, under a cooperative agreement with the EPA, assumed lead activities and initiated engineering assessments of the various properties in August, 1981. However, Mentor Corporation, owner of the Card property, denied the State access to the site.

The EPA resumed fund-lead activities in June, 1983, because the Colorado State Legislature failed to appropriate the state cost share for remedial planning required by EPA policy at the time. In December, 1983, the EPA directed its contractor, CH2M Hill, to conduct a Remedial Investigation (RI) of the Denver Radium Site to determine the nature and extent of the threat presented by the contamination and a Feasibility Study (FS) to evaluate proposed remedies. During the RI, Mentor Corporation allowed EPA access to the Card property so that the extent of the contamination present on the property could be determined.

Due to the enormity and complexity of the Denver Radium Site, the EPA determined that response actions could be undertaken as operable units in a cost-effective manner, consistent with a permanent remedy for the entire Denver Radium Site, and would decrease the release, threat of release, and pathways of exposure. Thus, the original Denver Radium Site properties plus several contiguous properties where contamination was discovered subsequent to the intial listing of the site on the Interim Priorities List were divided into eleven operable units, the Card property being Operable Unit X.

In April, 1986, the Denver Radium Site Remedial Investigation Report, which addresses all eleven operable units, was released to the public. A draft Card Corporation Operable Unit X Feasibility Study was released for public review on October 1, 1986. A second draft Card Corporation Operable Unit X Feasibility Study was released for public comment on April 24, 1987. The second draft report reflected public comments received on the first draft report and incorporated new requirements mandated by the passage of the Superfund Amendments and Reauthorization Act (SARA) in October, 1986. The final Card Corporation Operable Unit X Feasibility Study which incorporates responses to comments received during the both public comment periods will be released along with the Record of Decision (ROD) for the Card property.

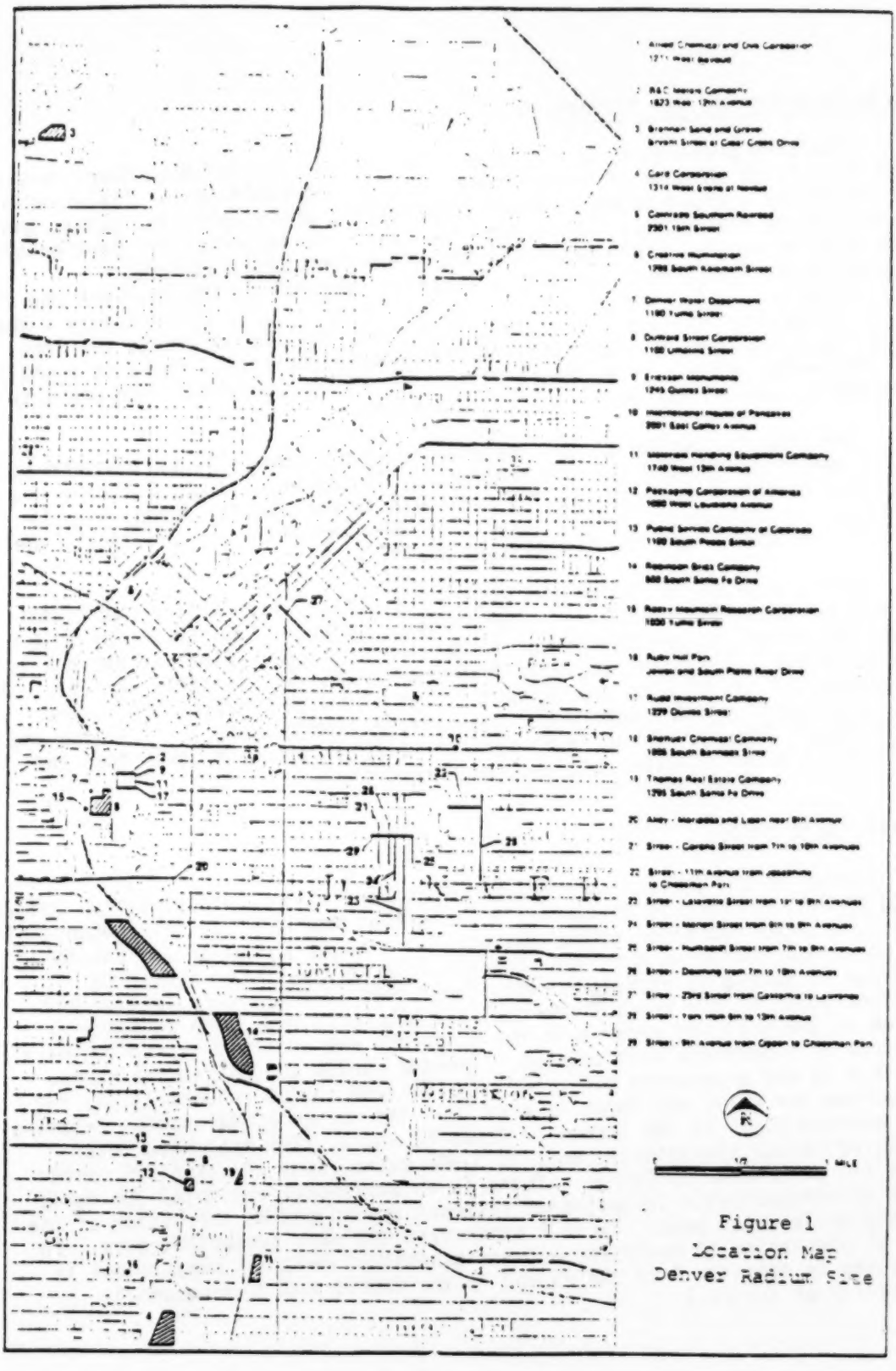


Figure 1
Location Map
Denver Radium Site

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Site Location and Description

The Card property is a 17.2-acre site located at 1314 West Evans Avenue. The site is in an area of Denver zoned I-2 for industrial use. Its ownership is currently divided between Mentor Corporation, which owns 13.7 acres, and Consolidated Freightways, which owns the rest. Mentor rents its portion of the site to various light manufacturing and warehousing companies. Consolidated Freightways operates a trucking terminal on the southern end of the property. There are currently five buildings on the Card property - the Brick Commercial building, the Office building, the UPL building, the True Truss building, and the Consolidated Freightways facility. There is a small oil and waste water pond on the eastern side of the property. The property is crossed by several currently unused rail spurs.

The site is bounded on the north and east by commercial offices and some light manufacturing and storage buildings. To the west is the Colorado and Southern Railroad property, and to the south is West Wesley Avenue and the Arapahoe generating station of the Public Service Company of Colorado. The nearest residences are two blocks east of the site.

The Card property is located within the Platte River Valley but is not within the designated 100-year flood plain. The site is underlain by fill material, alluvium, and the Denver formation sandstone. Depth to bedrock is approximately 10 feet and depth to ground water is approximately 20 feet. The topography of the site is predominantly flat although surface runoff tends eastward toward a storm sewer near the intersection of West Iliff Avenue and South Navajo Street. There is no surface water on the site other than the small oil and waste water pond mentioned earlier.

Current Site Status

Radium is the primary contaminant of concern at the Card property. Since gamma radiation readings in excess of background may indicate the presence of radium, a gamma radiation survey was used to outline the extent of possible radium contamination on the Card property (Figure 2). Gamma radiation readings in excess of background were found over 67,000 square feet of the site including in the Brick Commercial and UPL buildings. The presence of radium in the soil and underneath the buildings was verified by radiochemical analysis of subsurface soil samples. Average radium concentrations ranged from 4.4 to 472 picocuries per gram. The maximum radium concentration, 960 picocuries per gram, was found in area M2. The radium contamination extended to a maximum depth of 108 inches in Areas F2 and G. The estimated total volume of radium contaminated soil is 3,900 cubic yards of which 475 cubic yards lie underneath buildings. There is an additional estimated 200 cubic yards of radioactively contaminated sediment around and on the bottom of the oil and waste water pond. Table 1 summarizes the data presented above. (A general discussion of radiation and its associated units of measurement is presented in Appendix A of the FS and in the Public Health Assessment, Appendix B of the FS.)

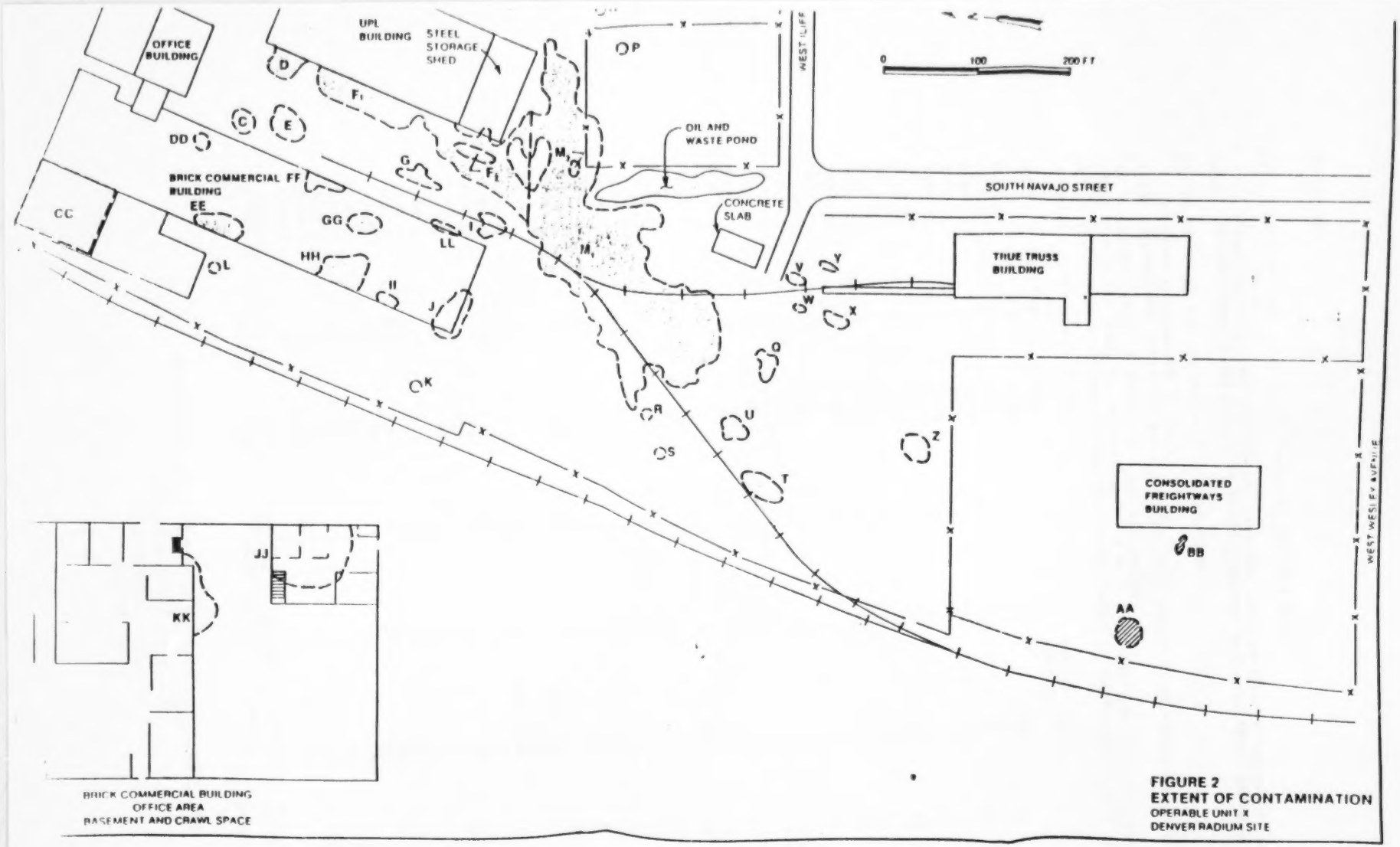

FIGURE 2
EXTENT OF CONTAMINATION
OPERABLE UNIT X
DENVER RADIUM SITE

Table 1
OPERABLE UNIT X
DENVER RADIUM SITE
SURFACE AND SUBSURFACE CONTAMINATION

Location	Volume (yd^3)	Area (ft^2)	Gamma (μR/hr) Average	Gamma (μR/hr) Maximum	Depth[a] (in.)	Radium Concentration (pCi/g) Average	Radium Concentration (pCi/g) Maximum
Area A	30	1,100	4	5	6 at 12-18	10.4	31
Area B	1	25	15	15	12	NA	NA
Area C	4	100	8	8	12	NA	NA
Area D	41	1,100	6	9	12	15.6	30
Area E	10	550	5	6	6	5.8	5.8
Area F1	300	8,100	7	21	12	8	34
Area F2	183	550	54	89	108	96.9	287.4
Area G	200	600	12	26	108	99	99
Area H	5	125	6	11	12	NA	NA
Area I	11	580	7	17	6	6.4	6.4
Area J	67	1,815	7	34	12	119.2	224
Area K	3	79	1	1	12	18	18
Area L	2	79	5	5	6	7.8	7.8
Area M1	2,500	33,720	13	95	Range from 0-30 Avg: 18	99.8	660
Area M2	33	180	12	12	60	236.9	960
Area N	5	130	5	5	12	8.4	8.4
Area O	18	110	8	8	54 at 12-66	47.5	182.5
Area P	6	150	6	34	12	202	685
Area Q	8	420	7	8	6	NA	NA
Area R	1	40	4	4	6	NA	NA
Area S	1	30	8	8	6	NA	NA
Area T	3	180	7	7	6	10	10
Area U	7	80	1	1	12 and 18 at 54-72	26.2 24.9	41 37
Area V	9	230	12	24	12	53.7	89
Area W	1	60	7	13	6	19	19
Area X	6	300	5	10	6	7.9	12
Area Y	2	110	7	14	6	5.6	5.6
Area Z	2	95	3	5	6	4.4	6.5
Area AA[b]	(32)	1,733	2	3	6	7.1	12
Area BB[b]	(2)	65	2	5	12	14.9	34
Area CC	145	7,800	4	6	6	NA	NA
Area DD	62	480	38	69	42	56.2	270
Area EE	53	1,430	5(11)	11(12)	12	12.1	28
Area FF	21	570	8	23	12	5.5	6.9
Area GG	15	800	9	16	6 at 12-18	60.5	282.1
Area HH	99	2,660	9	54	12	120	288
Area II	4	240	10	17	6	18	18
Area JJ	24	430	8	16	18	7.4	16
Area KK	4	110	NA	NA	12	472	900
Area LL (Wall)	NA	10	10	14	NA	6	6
Area MM	3	70	7	7	12	12	12
TOTAL	3,889	67,036			Maximum Depth: 108		

[a] Depth indicates the estimated depth of contamination. A range from x to y indicates a variation in the depth of contamination. x at y to z indicates a lens of contamination of thickness x under y inches of clean overburden.

[b] These contaminated locations are no longer identifiable after construction of the Consolidated Freightways facility.

[c] Areas AA and BB are not included in this total.

NOTE: Maximum gamma exposure rate is maximum surface grid scan gamma exposure rate. Gamma radiation readings are net readings above background, which in Denver is 15 μR/hr.

NA: Data not available or not recorded for this area.

The radium concentrations found on the Card property and the gamma radiation levels in places within the Brick Commercial and UPL buildings exceed the "EPA Standards for Remedial Actions at Inactive Uranium Processing Sites," 40 CFR Part 192, which the EPA has determined are relevant and appropriate Federal public health requirements for the Card property. These standards are discussed in detail later in this summary in the section entitled "Degree of Cleanup".

Radon decay product contamination resulting from the radium contamination on the site is not a concern on the Card property under present use of the property and existing site conditions. Slightly elevated radon decay product concentrations were detected in the Brick Commercial, UPL, and Office buildings; however, all measurements with one exception were well below the relevant and appropriate 40 CFR Part 192 standard of 0.02 working levels. The one measurement which exceeded the EPA standard was taken in a relatively small, unventilated location of the UPL building (a storage closet) and is not considered representative of the entire building.

Alpha particle radioactivity also resulting from the radium contamination on the site was not found in any significant degree in the Brick Commercial, Office, and UPL buildings. Of the 108 samples taken, only 14 had measurable levels of removeable alpha activity and all of the levels were well below the release limits specified by the Colorado Department of Health standards.

Minor amounts of non-radiological contamination, mainly polyaromatic hydrocarbons, were detected in the soils and in the pond sediments at the Card property. There is nothing to suggest that either dispersion or migration of these substances has occurred. No known sources of these compounds are present on the property at this time, and thus, there is no reason to suspect any additional releases. The Public Health Assessment of the Card property indicated that the non-radiological contamination represents a minimal concern relative to the radiological contamination present at the site. In addition, any remedy that reduces or eliminates the radiological hazard at the Card property will eliminate the known non-radiological hazards as well.

The elevated concentration of radium at the Card property poses a health hazard due to three principal potential exposure pathways. In order of decreasing significance, they are: (1) inhalation of radon gas, the immediate decay product of radium, and radon's own short-lived decay products, (2) direct gamma radiation exposure from the decay of radium and its progeny, and (3) ingestion or inhalation of radium-contaminated materials. Since radium is in a form that is relatively insoluble, and since migration of contaminants into the ground water or from the pond sediments into the pond water has not been noted, ingestion or contact with contaminated surface water or ground water is not one of the principal potential exposure pathways. Each of the three principal exposure routes will be discussed briefly in order to describe the potential health risks.

Inhalation of Radon Decay Products:

Radon gas and its decay products present the greatest health risk from long-term exposure. Radon gas decays to a series of short-lived particulates which are typically electrostatically charged at their formation and often attach themselves to airborne particles. If these contaminated particles are inhaled, then the lungs and other internal organs are exposed to the highly ionizing sub-atomic particles which the radon decay products emit. Prolonged inhalation of air which has a high concentration of radon decay products has been conclusively shown to cause lung cancer in uranium miners.

Dispersion quickly dilutes radon emanating from radium-contaminated ground. This mechanism will minimize the radon concentration in the air above the open areas of the Card property to such an extent that no one working on or living near the site is presently at risk from exposure to radon and its associated decay products. Radon decay products can concentrate to unacceptable levels in buildings built over contaminated ground if those buildings are energy efficient and well-sealed, that is, have little exchange of indoor air with outdoor air. However, this is not presently the case for the buildings on the contaminated portions of the Card property because the buildings have enough ventilation to keep the radon decay product concentration at low levels.

The analysis summarized above shows that there is no serious public health risk at present from the radon gas exposure pathway at the Card property. However, the EPA has determined that a significant increase in public health risk would occur if any of the contaminated material at the site is spread closer to potential receptors, especially if it is used as fill or construction material, or if any of the buildings on the site are sealed to make them more airtight, or if the site is ever redeveloped for any use that involves occupancy in enclosed, well-sealed structures. The Public Health Assessment summarized below presents projected cancer risks if the EPA were to take no action at the site and the Card property were redeveloped in any of these ways.

If a building were constructed over Area M1, the largest contaminated area on the Card property, and several conservative assumptions are made such as lifetime exposure, the estimated radon decay product concentration in the building would average 0.18 working level (WL) with an estimated maximum concentration of 1.2 WL. The radon decay product concentration in a typical U.S. home is 0.005 WL and the relevant and appropriate EPA standard, 40 CFR Part 192, is 0.02 WL. The projected cancer risk (excluding background) to individuals working in the building ranges from 190 to 790 cancer deaths per 10,000 persons exposed with a maximum projected cancer risk of 1,200 to 3,700 cancer deaths per 10,000 persons exposed. The projected cancer risk to individuals living in the building ranges from 1,100 to 5,600 cancer deaths per 10,000 persons exposed with a maximum projected cancer risk of 4,400 to 7,900 cancer deaths per 10,000 persons exposed.

These risk values can be compared to the projected cancer risk if the radon decay product concentration in the building was 0.02 WL, the EPA standard. In this case, the projected cancer risk to individuals working in

the building ranges from 23 to 91 cancer deaths per 10,000 persons exposed. The projected cancer risk to individuals living in the building ranges from 130 to 500 cancer deaths per 10,000 persons exposed. If the radon decay product concentration in the building was that of a typical U.S. home, 0.005 WL, then the projected cancer risk to individuals living in the building would range from 33 to 130 cancer deaths per 10,000 persons exposed. Areas M1 and M2 combined represent about 65% of the estimated total volume of contamination present at the site. It should be noted that these projected cancer risk numbers do not include the EPA-estimated spontaneous risk of lung cancer, that is, the risk not attributable to either smoking or radon. Table 2 presents the above stated information.

Gamma Radiation Exposure:

The radioactive decay of radium and its decay products results in the emission of highly penetrating gamma rays. Gamma rays are of concern because they can easily penetrate a few centimeters of soil to give anyone standing over a contaminated area a reasonably uniform irradiation over the whole body. The greater the duration or intensity of this exposure, the larger the dose, and hence the greater the risk of adverse health effects. The gamma radiation emmission is limited to the area immediately above the contamination.

As discussed previously, the EPA has determined that a significant increase in public health risk would result if any of the contaminated material on the Card property was disturbed and misused or if the area was redeveloped. If a building was constructed over the area with the highest gamma radiation readings, Area F2, the estimated annual dose to a person working in the building would average 109 millirem per year with an estimated maximum annual dose of 179 millirem per year. These doses are in addition to the background dose of 130 millirem per year incurred by those living in the Denver area and resulting from cosmic, terrestrial, and internal sources. The maximum allowable whole-body gamma radiation dose derived from the relevant and appropriate EPA standard, 40 CFR Part 192, and the National Council on Radiation Protection and Measurements (NCRP) and International Commission on Radiological Protection (ICRP) recommendation for a person in the workplace are 180 and 100 millirem per year, respectively, in addition to natural background and medical exposure. The estimated annual dose to a person living in a building built over Area F2 would average 355 millirem per year with an estimated maximum annual dose of 585 millirem per year. The whole-body gamma radiation dose derived from the relevant and appropriate EPA standard, 40 CFR Part 192, and the NCRP and ICRP recommendation for a residential occupant are 130 and 100 millirem per year, respectively, in addition to natural background and medical exposure.

The projected cancer risk from gamma radiation (including background) to individuals working in a building built over Area F2 would average 40 cancer deaths per 10,000 persons exposed with a maximum projected cancer risk of 47 cancer deaths per 10,000 persons exposed. The projected cancer risk to individuals living in the building would average 98 cancer deaths per 10,000 persons exposed with a maximum projected cancer risk of 1,200 cancer deaths per 100 persons exposed. Area F2 represents about 5% of the estimated volume of contamination on the site.

If individuals in any building were to receive a lifetime gamma radiation dose equivalent to that of the relevant and appropriate EPA standard, 40 CFR Part 192, then the projected cancer risk to those working in the building would average 31 cancer deaths per 10,000 persons exposed and the projected cancer risk to those living in the building would average 53 cancer deaths per 10,000 persons exposed. The projected cancer risk to individuals receiving a lifetime dose of 9.5 rem resulting from the Denver area background would be 27 cancer deaths per 10,000 persons exposed. It should be noted that cancer risks resulting from gamma radiation exposure are in addition to those resulting from inhalation of radon decay products. Table 2 presents the above state information.

Inhalation or Ingestion of Radium-Contaminated Material:

Inhalation of the long-lived radionuclides like uranium, thorium, and radium is possible for persons living or working on or near the Card property. Surface material suspended by the wind may contain small concentrations of these elements and the resulting airborne contamination is a potential human exposure pathway. Direct ingestion of long-lived radionuclides can result in significant doses to various internal organs of the body. However, studies by the U.S. Department of Energy have shown that the projected radiation dose from this source are many times smaller than those estimated for either radon decay product inhalation or direct gamma radiation exposure using even the most conservative assumptions. Also, it is unlikely that a person would ingest large amounts of the radium-contaminated material on the Card property and dust control measures ordinarily employed during excavation have been shown to provide sufficient control of exposure from this source. For these reasons, the EPA acknowledges this human exposure pathway, but no quantitative risk numbers were developed in the Public Health Assessment.

Low-levels of certain non-radiological carcinogenic contaminants were found in discrete locations on the Card property. The Public Health Assessment quantifies risks to human health from ingesting soil containing these contaminants. The projected cancer risks from this type of exposure range from .038 cancer deaths per 10,000 persons exposed to 1.2 cancer deaths per 10,000 persons exposed. These risk estimates are several orders of magnitude lower than the estimiated risks resulting from exposure to the radiological contamination on the property. Nonetheless, the presence of non-radiological contaminants on the site will be explicitly considered in all health and safety provisions of the cleanup.

The foregoing discussion demonstrates that a release or substantial threat of release of a hazardous substance or pollutant or contaminant into the environment has occurred at the Card property and that the release or threat of release may present an imminent and substantial endangerment to public health or welfare. It is also clear from the calculated risks that remedial action at the Card property is justified. The short- and long-term potential for adverse health effects from human exposure associated with the various remedial action alternatives evaluated for the Card property are discussed later in this summary.

Table 2
PROJECTED CANCER RISKS
OPERABLE UNIT X
DENVER RADIUM SITE

Scenario	Exposure	Average Cancer Deaths Per 10,000 Persons Exposed		Maximum Cancer Deaths Per 10,000 Persons Exposed	
Radon Decay Products:					
Building constructed over Area M1	0.18 WL	Workplace Residential	190 to 790 1100 to 5600	Workplace Residential	1200 to 3700 4400 to 7900
EPA Standard	0.02 WL	Workplace Residential	23 to 91 130 to 500		
Typical U.S. Home	0.005 WL	Residential	33 to 130		
Gamma Radiation:					
Building constructed over Area F2	54 μR/hr	Workplace Residential	40* 98*	Workplace Residential	47* 1,200*
EPA Standard	20 μR/hr	Workplace Residential	31* 53*		
Background	15 μR/hr	Residential	27		

* In addition to risk from exposure to background gamma radiation levels.

Enforcement

A detailed responsible party search for the entire Denver Radium Site has been initiated. Thus far, the search has not identified any parties responsible for the contamination on the Card property. Records show that Pittsburgh Radium Company owned and operated the radium processing facility at the time of disposal (circa 1920-1924) of radium, the hazardous substance of concern. Although extensive investigation has been conducted, the responsible party search has yet to trace the corporate history of Pittsburgh Radium Company to a viable, present-day company.

Mentor Corporation is a current owner of a large portion of the site. The responsible party search indicates that Mentor Corporation acquired the property in 1977 without knowledge of the contamination on the site. Further, it does not appear that (1) Mentor Corporation conducted or permitted the generation, transportation, storage, treatment, or disposal of any hazardous substance at the Card property or that (2) Mentor Corporation, since becoming aware of the contamination on its property, contributed to the release or threat of release of a hazardous substance at the facility through any action or omission.

Based upon these initial findings, EPA has begun negotiations with Mentor Corporation concerning a covenant not to sue for potential liability to the United States, including future liability, resulting from the release or threatened release of the hazardous substance to be addressed by remedial action at the Card property. The terms of this convenant not to sue are embodied in a draft administrative order on consent which is attacned to the ROD. Upon selection of the remedy and finalization of the responsible party search for the Card property, EPA will revise the draft administrative order to comport with the ROD and current laws. In exchange for this covenant not to sue, Mentor Corporation would agree to provide access to its property to enable EPA to undertake remedial action at the Card property and, at EPA's discretion, permit EPA to deliver for storage at the Mentor property radium-contaminated materials from other properties included in the Denver Radium Site.

Consolidated Freightways is a current owner of a portion of the Card property. Consolidated Freightways bought its portion of the property in March, 1985, nearly two years after the formal listing of the Denver Radium Site on the National Priorities List. During the summer of 1985, the company proceeded to construct a trucking terminal on the property and as a result two areas of contamination on the site can no longer be identified.

The EPA does not feel that remedial action should be delayed pending finalization of the responsible party search. EPA anticipates discussions and negotiations with both Mentor Corporation and Consolidated Freightways.

Further, if upon finalization of the search, the EPA identifies additional responsible parties, the EPA will formally notify them of the remedy selected in the ROD and initiate negotiations for the implementation of the remedy. Negotiations will not exceed sixty days. Thereafter, if the

responsible parties do not formally commit to performing the remedy in a timely manner, the EPA will proceed with a fund-financed remedial design and remedial action and will attempt to recover EPA's response costs from the responsible parties."

Degree of Cleanup

Pursuant to SARA Section 121(d), remedial actions shall attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and control of further release which at a minimum assures protection of human health and the environment. In addition, remedial actions shall, upon their completion, reach a level or standard of control for such hazardous substances, pollutants, or contaminants which at least attains legally applicable or relevant and appropriate Federal standards, requirements, criteria, or limitations, or any promulgated standards, requirements, criteria, or limitations under a State environmental or facility siting law that is more stringent than any Federal standard (ARARs).

On November 20, 1986, the EPA requested that the State of Colorado identify potentially applicable or relevant and appropriate state requirements for the Card property. On January 21, 1987, the State responded to this request and provided a list of Colorado requirements which the State believed pertained to the Denver Radium Site. Concurrently with this State activity, the EPA developed potentially applicable or relevant and appropriate Federal requirements. The EPA classified all applicable or relevant and appropriate requirements identified into four categories: contaminant-specific ARARs, action-specific ARARs, location-specific ARARs, and other Federal and State criteria, advisories, and guidance to be considered. A description of each of these categories is provided in both Chapter 4 and Appendix C of the FS. Tables C-1 through C-4 in Appendix C of the FS contain a brief description of each potential Federal and State requirement identified and EPA's analysis of each requirement's applicability or relevance and appropriateness to the Card property. The result of this analysis is summarized below.

Contaminant-specific ARARs:

The EPA Standards for Remedial Action at Inactive Uranium Processing Sites, 40 CFR Part 192, are one of two contaminant-specific ARARs identified for the Card property. For properties contaminated with uranium processing residues, these standards establish limits for the gamma radiation level and annual average radon decay product concentration in any occupied or habitable building and for the radium concentration in soil on open lands. Although not applicable to the Card property since the standards apply only to certain specifically designated sites where uranium was processed, the standards are relevant and appropriate to the Card property because (1) it is the radium content of the uranium mill tailings which is regulated; (2) the waste products resulting from uranium ore processing are very similar to those from both radium and vanadium ore processing; (3) the residues from both processes enter the environment through the same exposure pathways; and (4) the adverse health concerns resulting from exposure to the residues from both processes are the same.

The portion of the standard relevant and appropriate to the contaminated soil on the Card property is 40 CFR Section 192.12 which states:

> "Remedial actions shall be conducted so as to provide reasonable assurance that, as a result of residual radioactive materials from any designated processing site:
>
> (a) the concentration of radium-226 in land averaged over any area of 100 square meters shall not exceed the background level by more than -
>
> (1) 5 pCi/g, averaged over the first 15 cm of soil below the surface, and
> (2) 15 pCi/g, averaged over 15 cm thick layers of soil more than 15 cm below the surface."

(40 CFR Section 192.12.)

The portion of the standard relevant and appropriate to the buildings on the Card property is 40 CFR Section 192.12(b) which states:

> (b) In any occupied or habitable building -
>
> (1) The objective of remedial action shall be, and reasonable effort shall be made to achieve, an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 WL. In any case, the radon decay product concentration (including background) shall not exceed 0.03 WL, and
> (2) The level of gamma radiation shall not exceed the background level by more than 20 microroentgens per hour.

(40 CFR Section 192.12(b).)

Even though the radon decay product concentration in the buildings is well below the 0.02 working level standard, some gamma radiation measurements in the Brick Commercial building exceed 20 microroentgens per hour.

The second contaminant-specific ARAR identified for the Card property is the Nuclear Regulatory Commission Standards for Protection Against Radiation, 10 CFR Part 20. These regulations establish standards for protection against radiation hazards arising out of activities under licenses issued by the Nuclear Regulatory Commission (NRC). Because these standards apply to licensed NRC facilities, they are not applicable to the Card property. However, EPA has determined that portions of the regulations are relevant and appropriate to individuals who would be conducting the remedial action on the Card property. In particular, Appendix B of 10 CFR Part 20 provides limits for airborne concentrations of natural uranium, thorium-230, and radium-226. Gamma radiation dose standards for individuals in restricted and unrestricted areas are cited in 10 CFR Sections 20.101 and 20.105, respectively. These 10 CFR Part 20 standards along with the 40 CFR Part 192 standards are summarized in Table 3.

Table 3
POTENTIAL CONTAMINANT-SPECIFIC ARAR'S
OPERABLE UNIT X, DENVER RADIUM SITE

Regulatory Agency	Type of Contaminant	Standard, Requirement, Criteria, or Limitation	Comments
FEDERAL			
U.S. EPA-40 CFR Part 192, Subpart B-Standards	Radium-226 Concentration	5 pCi/g above background within 15 cm of the surface measured over a 100-m^2 area 15 pCi/g above background within subsequent 15 cm layers measured over a 100-m^2 area	Standards for cleanup of open lands or buildings; concentration of radium-226 in land, averaged over any area of 100 square meters.' Point of compliance is at any contaminated area greater than 100 m^2. However, during cleanup all contaminated ares would be remediated.
	Gamma radiation[a]	20 µR/hr above background	Relevant and appropriate to indoor gamma radiation. Point of compliance is inside any site building.
	Radon Decay Product Concentration	0.02 WL annual average 0.03 WL maximum	Relevant and appropriate to indoor radon. Point of compliance is inside any site building.
Nuclear Regulatory Commission (NRC) 10 CFR Part 20	Uranium-natural Airborne Concentrations	5 pCi/m^3, Unrestricted area[b] 100 pCi/m^3, Restricted area[c]	Point of compliance is any location within site.
	Thorium-230 Airborne Concentrations	3 pCi/m^3, Unrestricted area[b] 30 pCi/m^3, Restricted area[c]	Point of compliance is any location within site.
	Radium-226 Airborne Concentrations	3 pCi/m^3, Unrestricted area[b] 30 pCi/m^3, Restricted area[c]	Point of compliance is any location within site.
	Gamma radiation[a]	5 rem/yr, (5,000 mrem/yr) Restricted area 500 mrem/yr, Unrestricted area	Point of compliance is any location within site; site would be unrestricted for remediation workers.

[a]Relevant and appropriate standard but not as protective as Other Guidance; see Table 4-3.

[b]An unrestricted area is regarded as any place around a waste consolidation/storage area facility where access is not controlled.

[c]A restricted area is regarded as any place around a waste consolidation/storage area where access is controlled.

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Location-specific ARARs:

The Colorado Historical Society has made a preliminary determination tnat the Card property is eligible for inclusion in the National Register of Historic Places. This finding was based on the property's earlier industrial importance as a radium processing facility. The EPA has determined that both the National Historic Preservation Act and the Archeological and Historic Preservation Act are location-specific ARARs. Remedial action at the Card property will not adversely affect the historic character of the site. Nonetheless, the EPA will continue to cooperate with the Colorado Historical Society by providing documentation lending historical significance to the property and will adhere to the requirements of the aformentioned Acts.

Action-specific ARARs:

The EPA has identified several action-specific ARARs. Since these ARARs are technology-based restrictions triggered by specific types of remedial measures under consideration they were considered along with the development of remedial action alternatives and will be discussed in the next section entitled "Alternatives Evaluation".

Other Criteria to be Considered:

In the category of other Federal and State criteria, advisories, and guidances the EPA determined that when selecting the remedy it would consider the National Committee on Radiation Protection and Measurements (NCRP) and International Commission on Radiological Protection (ICRP) guidelines. The NCRP and ICRP recommend a maximum gamma radiation dose to the whole body of 100 millirem per year for all sources except medical and natural background for chronic exposure situations.

Pursuant to the NCP, 40 CFR Section 300.68(a)(3) and SARA Section 121, Federal, State, and local permits are not required for on-site fund-financed remedial actions. However, the EPA expects that non-environmental and construction permits will be required in carrying out CERCLA Sections 104 and 106 onsite response actions. The EPA will also take steps to ensure that offsite disposal of any contaminated material removed from Card property is consistent with the EPA's offsite disposal policy, that is, final disposal will be at a facility suitable for the disposal of the Denver Radium Site wastes.

Alternatives Evaluation

The EPA evaluated potential remedial action alternatives for the Card property by progressing through the series of analyses which are outlined in the National Contingency Plan (NCP), in particular, 40 CFR Section 300.68, and the Interim Guidance on Superfund Selection of Remedy, December 24, 1986, (OSWER Directive No. 9355.0-19). This process in part enables the EPA to address the SARA Section 121 requirements of selecting a remedial action that is protective of human health and the environment, that is cost-effective, and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

The selection of remedy process begins by identifying certain site-specific information to be assessed in determining the types of response actions that will be considered for the site. A general list of site-specific information is contained in Section 300.68(e)(2) of the NCP. This list was used to identify specific site and waste characteristics of the Card property. (See Table 5-1 of the FS.) Based upon these site and waste characteristics, the EPA was able to scope, from the universe of all possible response actions, a set of response actions and associated technologies to be considered for the Card property. An example of this scoping process was the elimination of ground water barriers from further consideration because ground water contamination is not a characteristic of the Card property. Appendix D of the FS illustrates the scoping process and Table 5-2 of the FS details the results.

Section 121(b)(1) of SARA states that, "The President shall conduct an assessment of permanent solutions and alternative treatment technologies or resource recovery technologies that, in whole or in part, will result in a permanent and significant decrease in the toxicity, mobility, or volume of the hazardous substance, pollutant, or contaminant." As part of this process, the EPA evaluated permanent solutions to the problems associated with the specific hazardous substances present on the Card property. The necessity to find a treatment technology which successfully reduces the mobility, toxicity, and volume of a hazardous substance presents a problem since the hazardous substance associated with the Card property is a radioactive element. The characteristic of spontaneously emitting energy and subatomic particles is a property inherent to each atom of a radioactive element and which cannnot be altered or destroyed by any chemical or physical treatment known today. Most treatment and resource recovery technologies concentrate the radioactive elements present in the waste, increasing toxicity without significantly reducing volume or mobility. These treatment and resource recovery technologies often also leave a waste product which is still radioactive. Nonetheless, EPA considered several treatment and resource recovery technologies along with more conventional response actions such as capping or excavation. These alternative treatment technologies include sand sifting, in situ vitrification, and reprocessing.

Before the technologies were assembled into remedial action alternatives, they were categorized as either source control or management of migration measures and then prescreened based on their suitability to abate the threat at the Card property. Source control measures are intended to contain the hazardous substances onsite or eliminate the potential for contamination altogether by transporting the hazardous substances to a safer location. Management of migration actions are taken to minimize and mitigate the migration of hazardous substances. Management of migraton measures have particular importance at the Card property since radon gas, alpha particles, and gamma rays are continuously being released from the source, radium. The results of the prescreening of both source control and management of migration measures based on their suitability to abate the threat at the Card property are presented in Table 5-3 of the FS.

The next step of the selection of remedy process is assembling the remaining technologies and/or disposal options into remedial action alternatives. Section 300.68(f)(2) of the NCP requires EPA to develop remedial action alternatives in a range of categories which are based in part upon ARAR attainment. The OSWER Directive No. 9355.0-19, "Interim Guidance on Superfund Selection Remedy" requires EPA to develop remedial action alternatives ranging from those that would eliminate the need for long-term management (including monitoring) at the site to alternatives involving treatment that would reduce toxicity, mobility, or volume as their principal element. Alternatives developed in this way will vary mainly in the degree to which they rely on long-term management of treatment residuals or low-concentrated wastes. The OSWER Directive also instructs EPA to develop a containment option involving little or no treatment and a no action alternative.

Alternatives developed in the FS for the Card property were:

1. No Action

2. Deferred Removal, Offsite Permanent Disposal

3. Onsite Reprocessing/Treatment, Offsite Permanent Disposal

4. In Situ Vitrification

5. Onsite Permanent Disposal

6. Offsite Permanent Disposal

7. Onsite Temporary Land Storage, Offsite Permanent Disposal

8. Onsite Temporary Building Storage, Offsite Permanent Disposal

9. Onsite Temporary Containment (Capping), Offsite Permanent Disposal

Table 4 provides a comparison of each of the alternatives listed above with the alternative categories specified in Section 300.68(f)(2) of the NCP.

Table 4

NCP ALTERNATIVE CATEGORIES

OPERABLE UNIT X

DENVER RADIUM SITE

NCP Category	Common Elements	Alternative Number 1	2	3	4	5	6	7	8	9	Comments
1. Complete removal and subsequent treatment or disposal at an offsite facility.	X		X				X	X	X	X	Complete removal of oily layer and decontamination of wall material; complete removal of soils and sediments.
2. Attain applicable or relevant and appropriate Federal and State public health and environmental requirements					X						Vitrification and capping might attain ARAR's.
3. Exceed applicable or relevant and appropriate Federal and State public health and environmental requirements						X	X				Onsite and offsite disposal could be designed and implemented to exceed ARAR's.
4. Does not attain Federal and State requirements but reduces present or future threat and provides significant protection to public health and the environment				X				X	X	X	Reprocessing may not provide a non-radioactive soil after treatment; significant reduction could occur. Temporary measures will probably not meet ARAR's until the contaminated materials are removed from the site and placed in an offsite disposal facility. Alternatives 7 and 8 could temporarily reduce exposure to radioactive materials. Alternative 9 could reduce exposures, depending upon thickness of the cap.
5. No action		X					•				Also serves as a baseline for comparison.

Alternatives 2, 3, 6, 7, 8, and 9, since they require the permanent offsite disposal of contaminated material, would eliminate the need for long-term management (including monitoring) at the Card property. Alternatives 3 and 4 involve treatment as their principal element, but do not necessarily reduce the mobility, toxicity, or volume of the waste. Alternative 3 necessarily includes a provision for the permanent disposal of the treatment residues. Alternatives 4 and 5 require permanent onsite remedies, and hence, long-term management and monitoring at the Card property. Finally, No Action was included as Alternative 1.

Alternatives 7, 8, and 9 were developed to include temporary response measures followed by permanent offsite disposal of the contaminated material when a facility for such a disposal becomes available. Alternative 6, Offsite Permanent Disposal, is not immediately implementable because the State of Colorado has not at this time designated a facility for the disposal of the Denver Radium Site wastes. Pursuant to CERCLA Section 104(c)(3)(C)(ii), it is the responsibility of the State to assure the availability of a disposal site. Also, in order to comply with SARA 104(k), and in order to assure that remedial actions within Colorado continue, the State must provide adequate assurance of the availability of a hazardous waste treatment or disposal facility within three years from the effective date of SARA, October 17, 1986. Although progress is being made to this end, the State does not expect to have a fully operational disposal facility for up to five years. In the meantime, in its presently uncontrolled state, the radium-contaminated material at the Card property could be misused or inadvertantly spread, possibly increasing the risk to present or future public health, welfare, or the environment. In addition, the cost of final remedial action is liable to increase due to inflation; the Card property owners and tenants face economic losses associated with restricted use of their properties; and the EPA may incur further costs by updating site studies in the face of changing site conditions. The EPA determined that developing alternatives which include temporary response actions was not only justified, but necessary in order to effectively mitigate or minimize threats to and provide adequate protection of public health, welfare, or the environment at the Card property.

Once the remedial action alternatives were developed, it was possible to identify action-specific ARARs. These ARARs are distinct from the contaminant-specific and location-specific ARARs identified earlier in this summary in that action-specific ARARs are technology-based restrictions triggered by specific action elements associated with the remedial action alternatives under consideration. The following action elements are part of at least one or more remedial action alternative developed for the Card property:

- removal of the oily layer of the oil and waste water pond
- removal of soils and sediments
- removal of wall material
- permanent onsite disposal

- permanent offsite disposal

- temporary onsite storage or containment

- treatment or reprocessing

Potential action-specific ARARs for the action elements listed above were considered in Appendix C of the FS and are presented in Table 6-3 of the FS.

Initial screening, which is the next step in the selection of remedy process, narrows the list of potential remedial action alternatives requiring detailed analysis. Consistent with 40 CFR Section 300.68(g) and the OSWER Directive 9355.0-19, the remedial action alternatives developed for the Card property were initially screened using the criteria of cost, implementability (acceptable engineering practices), and effectiveness. Table 7-1 in the FS summarizes the initial screening process. Alternatives 1, 2, 5, 7, and 8 passed the initial screening and were carried forward for detailed analysis while Alternatives 3, 4, 6, and 9 were screened primarily for the reasons set forth below.

Alternative 3, Onsite Reprocessing, was eliminated from further consideration based on its lack of effectiveness. Since both the reprocessed soil and the concentrated precipitate resulting from the reprocessing of the soil would require disposal in a facility that meets the requirements of 40 CFR Part 192, this alternative would provide no additional benefit to public health or the environment over other alternatives to be considered. Alternative 4, In Situ Vitrification, was eliminated during the initial screening because its implementability for this particular application is unproven. In situ vitrification has not been demonstrated on a large scale or utilized in a highly-populated urban area like that of the Card property. The extreme temperature requirements of this process could cause unknown damage to onsite structures and any buried utilities or pipelines. Once vitrified, a cap over the area might be necessary to limit the escape of radon gas and associated radon decay products. Furthermore, the property would have to be permanently dedicated as a disposal site and measures would have to be taken to prevent human contact with or disturbance of the vitrified material. Finally, this alternative would require long-term government ownership, licensing, management, and monitoring to protect the integrity of the vitrified mass. These requisites would conflict with current and proposed land uses for the area, as well as State policies on siting disposal facilities.

With the elimination of these two alternatives, no alternatives which involve treatment as a principal element survive the initial screening. However, EPA has no reasonable belief that either of these alternatives offers the potential for better treatment performance or implementability, lesser adverse impacts, or lower costs than demonstrated alternatives.

Alternative 6, Permanent Offsite Disposal, was eliminated during initial screening because it is not implementable at this time. As discussed earlier, the State of Colorado has not at this time designated a facility for the

disposal of the Denver Radium Site wastes. Alternative 9, Temporary Onsite Capping, Permanent Offsite Disposal, was eliminated during initial screening because it is neither as effective nor as implementable as similar alternatives, Alternatives 7 and 8, and would cost almost as much as other alternatives that achieve the same objectives.

Following is a description of the remedial action alternatives surviving the initial screening.

1. No Action

   If this alternative were selected, no action would be taken at the contaminated Card property. This alternative was retained for further analysis and consideration as required by the NCP (40 CFR Section 300.68(f)(1)(v)).

2. Deferred Removal, Permanent Offsite Disposal

   This alternative would defer removal of the contaminated material at the Card property until an approved permanent offsite disposal facility is identified and made available by the State of Colorado. Once this facility becomes available, the entire estimated 4,000 cubic yards of contaminated soils and sediments on the Card property, which includes the estimated 475 cubic yards of contaminated soils lying under the Brick Commercial and UPL buildings, would be excavated. The material would then be transported by either truck or rail for final disposal at this facility. The Card property would then be available for unrestricted use.

5. Permanent Onsite Disposal

   This alternative entails the excavation of the approximately 4,000 cubic yards of contaminated material on the property and disposal onsite in a facility constructed in accordance with 40 CFR Part 192 Subparts A and B. The disposal area would require permanent access restrictions and long-term monitoring. A buffer zone would be created between the disposal facility and the surrounding businesses. In accordance with SARA Section 121(c), a review of the permanent onsite disposal facility would be required no less than every five years.

7. Temporary Onsite Land Storage, Permanent Offsite Disposal

   This alternative would provide temporary storage of the estimated 4,000 cubic yards of contaminated material until a permanent offsite disposal facility becomes available. There are several options for the land-based storage facility including an asphalt pad with a suitable cover. The storage facility would require security precautions, radiation monitoring, and regular inspections. An option associated with this alternative is the use of the temporary

facility for storage and staging of material from certain other Denver Radium Site properties. Once a permanent offsite disposal facility becomes available, then the contaminated material would be sent by truck or rail to the facility. The Card property would then be available for unrestricted use.

8. Onsite Temporary Building Storage, Offsite Permanent Disposal

This alternative consists of excavating the approximately 4,000 cubic yards of contaminated material, placing the material in reinforced synthetic bags, and storing the bags in the True Truss Building until a permanent offsite disposal facility becomes available. As with Alternative 7, an option associated with this alternative is to bring material from certain other Denver Radium Site properties for staging and storage in the True Truss building. Once a permanent offsite disposal facility becomes available, the contaminated material would be transported by either truck or rail to the facility. The True Truss building would be decontaminated, then demolished and the material sent to a sanitary landfill. The Card property would then be available for unrestricted use.

Common to all of the remedial action alternatives briefly described above with the exception of Alternative 1, No Action, is the response actions that would be taken for the decontamination of the contaminated portion of wall within the Brick Commercial building and the removal of the water and the oily layer from the oil and waste water pond. The contaminated portion of wall within the Brick Commercial building would be decontaminated by surface scrubbing or by possible removal of the brick wall surface. Any wall material requiring removal would be disposed of along with the contaminated soils and sediments which are present on the Card property.

The oily layer of the oil and waste water pond would be tested for radioactive and nonradioactive contamination. If only radioactively contaminated, the oil would be handled with the contaminated site soils and sediments. If contaminated only with hazardous substances, depending on the amount and type of nonradiological contaminants, the waste would be transported to a hazardous waste disposal or treatment facility or an industrial boiler or furnace for energy recovery.

If testing reveals both radiological and nonradiological contaminants, the oily layer could be a mixed waste as defined in the OSWER Directive No. 9440.00-1, "Guidance on the Definition and Identification of Radioactive Mixed Wastes" (EPA, 1987) and would have to be handled in accordance with restrictions on such waste.

The standing water in the oil and waste water pond would also be tested. If uncontaminated, the water would be either evaporated or used for onsite dust control if removal or excavation measures are implemented. If contaminated, the water would be evaporated and the remaining sludge would be handled with contaminated site soils and sediments or, if necessary, as a mixed waste.

Consistent with Section 300.68(h) of the NCP and the OSWER Directive No. 9355.0-19, the remedial action alternatives remaining after initial screening were further refined and then subject to detailed analysis. Detailed analysis of each alternatiave entailed evaluation based on the three broad criteria of implementability, effectiveness, and cost. For each of these broad criteria, the EPA identified appropriate and more specific "component measures" so that the remedial action alternatives could be compared to each other using a full array of evaluation factors. The component measures derived for implementability, effectiveness, and cost were based upon specific requirements and criteria contained in Section 300.68(h)(2) of the NCP, SARA Sections 121(b)(1)(A through G), SARA Section 121(c), and the OSWER Directive No. 9355.0-19 discussion on detailed analysis.

The component measures of implementability are: technical feasibility, constructability, reliability, administrative concerns, availability of technology, and operation and maintenance. The component measures of effectiveness are: ARAR attainment; effectiveness in significantly and permanently reducing mobility, toxicity, and volume; persistance, toxicity, mobility, and propensity to bioaccumulate of the hazardous substances and their constituents; protectiveness/health effects; environmental protectiveness/potential for adverse environmental impacts; and compliance with the Solid Waste Disposal Act. The component measures of cost are: capital costs, operation and maintenance costs, and potential future remediation costs if the alternative fails. Chapter 8 of the FS provides a comparative review of each remedial action alternative based upon each of the component measures listed above. Table 5 summarizes the detailed analysis of alternatives. The selected remedy was chosen after the detailed analysis of alternatives and is discussed in the next section.

Selected Remedy

EPA's preferred remedial action alternative for the Card property is Alternative 6, Permanent Offsite Disposal. This alternative, however, was eliminated during the initial screening of alternatives because until the State of Colorado identifies a permanent disposal site for material from the Card property, this alternative cannot be implemented. EPA has therefore determined that the appropriate extent of remedy at the Card property is Temporary Onsite Building Storage/Permanent Offsite Disposal, Alternative 8. In the event that a permanent disposal facility becomes available before Alternative 8 is implemented at the Card property, EPA may immediately implement Alternative 6, Permanent Offsite Disposal.

Temporary Onsite Building Storage/Permanent Offsite Disposal, Alternative 8, is protective of human health and the environment and attains or exceeds the relevant and appropriate Federal and State public health and environmental requirements that have been identified for the Card property. As determined during the detailed analysis, this alternative is a cost effective remedy that effectively mitigates and minimizes threats to and provides adequate protection of public health, welfare, and the environment.

Table 5
SUMMARY OF ALTERNATIVE EVALUATION
OPERABLE UNIT X, DENVER RADIUM SITE

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Deferred Removal/ Permanent Offsite Disposal	Alternative 5 Onsite Disposal	Alternative 7 Temporary Onsite Land Storage/ Permanent Offsite Disposal
o Implementability	o Feasible	o Site could undergo additional development (i.e., Consolidated Freightways) in contaminated area. Contaminated materials could be dispersed or diluted such that they would no longer be identifiable. o Excavation cannot proceed until an offsite disposal facility is available. Availability required by SARA 104 (k). Facility is assumed not to be available until 1992.	o Land disposal facilities can have technical problems, such as seepage; moderate potential for component failure exists. During construction of disposal facility, clean materials could be dispersed onsite resulting in dilution of contaminated soils. o Condemning site for a 1,000-year storage facility plus the historical aspects of the site could create problems that may delay implementation. Site access restrictions are mandatory; the site would be dedicated for use as a storage facility for low-level radioactive wastes for the indefinite future.	o Temporary storage can have technical problems, such as ripping of the synthetic liner or cracks in the asphalt pad. o Temporary storage would be used until offsite disposal facility is available. Availability required by SARA 104(k). Facility is assumed not to be available until 1992. o Site access restrictions and approvals would be needed to construct the asphalt pad storage unit. Storage facility would severely restrict usage of overall site for 5 years, since it would occupy a large percentage of open space at the site.
o Effectiveness	o 40 CFR 192 conditions for radium-226 in soils would not be attained. If the property is redeveloped, protectiveness levels for radon would not be attained. o NCRP/ICRP guidance for gamma radiation may not be met if the property is redeveloped. o No Action does not reduce mobility, toxicity, and volume of site radioactive materials. o Radioactive materials are extremely persistent; radium is not very mobile and gives off radon decay products to the atmosphere. While not very soluble after reprocessing, radon is subject to dispersal via human activity. Radon decay products can accumulate in human lungs and are carcinogenic. Gamma radiation could cause cancer or genetic defects.	o While removal is deferred, 40 CFR 192 radon and 10 CFR 20 airborne concentration ARAR's may not be met unless use restrictions and controls are implemented. Radium-226 levels in soil would not be met until removal.	o 40 CFR 192 and 10 CFR 20 standards would be met by a properly designed, constructed, and implemented facility. Site cleanup would result in gamma radiation and radon levels that are below standards. o 6 CCR 1007-1 (Colorado Rules and Regulations Pertaining to Radiation Control) siting objectives would not be met because the disposal facility would be in a populated area.	

Table 5
(continued)

Evaluation Criteria	Alternative 1[a] No Action	Alternative 2 Deferred Removal/ Permanent Offsite Disposal	Alternative 5 Onsite Disposal	Alternative 7 Temporary Onsite Storage/ Permanent Offsite Disposal
o Effectiveness (continued)		o During excavation, remedial action workers would be exposed to approximately 162 mrem/yr (whole body Dose Equivalent), which is below the 10 CFR 20 standard of 500 mrem/yr for workers. Onsite workers that are not associated with cleanup would be exposed to approximately 7.4 mrem/yr, which is below the NCRP/ICRP guidance of 100 mrem/yr for chronic exposure to the general public. Transportation of 350 miles to offsite disposal facility would involve driver exposure of 6.4 mrem/per trip. Minimal exposure would occur to general public during transportation, unless an accidental spill occurred, which would result in a minor increase in exposures.	o During excavation, remedial action workers would be exposed to 171 mrem/yr (whole body Dose Equivalent), which is below the 10 CFR 20 standard of 500 mrem/yr. Onsite workers who are not associated with cleanup would be exposed to approximately 7.6 mrem/yr which is below the NCRP/ICRP standard of 100 mrem/yr.	o The facility should be protective of the environment if appropriate liners and caps are used. Potential impacts could occur during removal (both for placement in the temporary facility and the permanent offsite facility) if uncontrollable dispersal occurs to the environment. o During excavation, remedial action workers would be exposed to approximately 162 mrem/yr (whole body Dose Equivalent), which is below the 10 CFR 20 standard of 500 mrem/yr. Onsite workers who are not associated with cleanup would be exposed to 7.4 mrem/yr, which is below the NCRP/ICRP guideline of 100 mrem/yr and the 40 CFR 190 standard of 25 mrem/yr at the facility boundary. Transportation exposures would be identical to Alternative 2. o If other Denver Radium property wastes are temporarily stored onsite, remedial action workers would be exposed to approximately 214 mrem/yr. Exposure to workers not associated with cleanup would increase to approximately 10.6 mrem/yr. In-town truck drivers would be exposed to approximately 200 mrem/yr, which is below the 10 CFR 20 standard of 500 mrem/yr. o Consolidating uncontrolled wastes from other Denver Radium properties at this site would probably provide increased overall protection of the environment. Dispersal risk at these other properties would be reduced.
o Costs	Not Applicable	o Capital PW[a]--$731,500 O&M[b] PW--$22,700	o Capital PW--$1,354,000 O&M PW--$1,333,400	o Capital PW--$1,501,400 O&M PW--$244,500

[a] PW = present worth at a 10 percent discount factor.

[b] O&M = Operations and Maintenance

Table 5
(Continued)

Evaluation Criteria	Temporary Onsite Containment/ Permanent Offsite Disposal Alternative 8	Common Elements (Contaminated Wall and Oily Layer)
o Implementability	o Synthetic bags could rip and spill material in the building. However, the building should contain any spilled materials. o Temporary storage would be used until offsite disposal facility is available. Availability required by SARA 104(k). Facility is assumed not to be available until 1992. o Approvals for using True Truss Building for radioactive material storage have been tentatively obtained.	o Minimal potential for poor decontamination performance, since wall could always be completely removed. Oily layer, as a liquid, could present handling problems; risk of failure during removal is minimal.
o Effectiveness	o Temporary storage facility would not meet 40 CFR 192 and 10 CFR 20 standards for gamma radiation and radon unless ventilation is used. However, radium standards in soils would be met upon initial removal. o Access restrictions during the storage period would limit public appreciation of historic value of the site. o The mobility of the material would be decreased unless the container broke; however, the use of a building for storing the containers would contain any spillage. The mobility of radon gas could be decreased, but could still present a problem within the container building used for storage. o If other Denver Radium property wastes are consolidated and stored at the Card Corporation site, the volume of material will significantly increase.	o Cleanup of the wall material would be remediated as part of the cleanup for the site. o Colorado Department of Health regulates alpha particle emissions; these standards would be met during decontamination. Pond water would be evaporated.

Table 5
(Continued)

Evaluation Criteria	Temporary Onsite Containment/ Permanent Offsite Disposal Alternative 8	Common Elements (Contaminated Wall and Oily Layer)
o Effectiveness (continued)	o During excavation, remedial action workers would be exposed to approximately 162 mrem/yr (whole body Dose Equivalent), which is below the 10 CFR 20 guideline of 500 mrem/yr and the 40 CFR 190 standard of 25 mrem/yr at the facility boundary. Onsite workers that are not associated with cleanup would be exposed to approximately 7.4 mrem/yr, which is below the NCRP/ICRP standard of 100 mrem/yr. Transportation risks would be identical to Alternative 2.	
o Costs	o Capital PW--$1,028,100 o O&M PW--$89,500	Included in Alternative Estimates

The selected remedy does not satisfy the statuatory preference for treatment which reduces toxicity, mobility, and volume of the hazardous substances as a principal element. EPA evaluated several treatment technologies, including sand sifting, reprocessing, and in situ vitrification. None were found to be suitable to the site conditions or the type of contamination present on the Card property.

As described earlier, Temporary Onsite Building Storage/Permanent Offsite Disposal would provide safe, temporary storage of the approximately 4,000 cubic yards of radium-contaminated soil from the Card property until a permanent offsite disposal facility is made available by the State of Colorado. The material would be excavated from the property, placed in reinforced synthetic bags, and the bags placed in the True Truss building located near the southern end of the Card property. If extra capacity is necessary to store the entire volume of material, an addition to the True Truss building could be constructed. Upon the availability of a permanent disposal facility, all material would be removed from the property and transported by either rail or truck to the permanent offsite disposal site. The True Truss building and any additions would be dismantled, decontaminated, and the material disposed of in a sanitary landfill.

This alternative includes the option of consolidating and storing radium-contaminated material from a select few other Denver Radium Site properties. EPA initially considered bringing up to 40,000 cubic yards of material from other Denver Radium Site properties, but because of concerns raised by elected officials and the neighboring community, EPA decided to limit the maximum amount of material that could be stored at the Card property to 13,000 cubic yards. Factors that will be considered in determining whether material from the other properties will be brought to the storage facility include capacity of the storage facility, timing, and the comparative health and environmental threats posed by the other Denver Radium Site properties whose cleanup would be facilitated by temporary offsite storage. No material would be brought from any Denver Radium Site property where EPA determines during the selection of remedy process for that property that an onsite remedy could be implemented, e.g., there is sufficient space for an onsite action, and where there is direct access at the property to a rail line for transportation to a permanent offsite disposal facility.

In further response to public concerns about temporary storage on the property, EPA also decided to limit the duration of the temporary storage. EPA initially considered a duration of storage extending for as much as three years additional time beyond the initial five year period if no disposal facility had been made available by the State. But in response to comments, EPA has decided to limit the maximum amount of time for temporary storage at the Card property to five years.

The present worth cost of this alternative is $1,148,000. This includes excavation of all contaminated material, placement of the material in the bags, placement of the bags in the True Truss building, and maintenance and monitoring of the bags and building for 5 years. The cost also includes removal and transportation of the contaminated material to the offsite disposal facility, as well as dismantling and decontaminating the building, and transporting the material to a sanitary landfill.

Operation and Maintenance

Operation and maintenance activities will be required to ensure the effectiveness of the temporary storage facility. The total of discounted annual operation and maintenance costs, using a time period of five years and a discount rate of 10%, is $89,500. This figure could vary depending upon the State's progress towards identifying a permanent disposal site. Operation and maintenance activities include site inspections and possible minor structural repairs. EPA will have lead responsiblility for all operation and maintenance activities during temporary storage. The costs of operation and maintenance during temporary storage will be shared between EPA and the State of Colorado in the same manner as other aspects of remedial action.

Community Relations

The Denver Radium Site Community Relations Plan establishes a means for communicating information and eliciting comments concerning the site from State and local officials, potentially interested neighborhood associations and individuals, and the local media. The EPA issued a press release announcing the October 6 through November 15, 1986 public comment period on the first draft Card Corporation Operable Unit X Feasibility Study. The Denver Post, the Rocky Mountain News, and the Washington Park Profile provided news coverage. A great deal of public interest resulted. The EPA received numerous letters and several petitions, most of which opposed the use of the Card property as a storage facility. The Denver City Council passed a resolution against the storage of any radioactive waste anywhere in the Denver metro area.

So great was the public concern, that the EPA extended the public comment period to November 30 and held a public meeting on November 19, 1986. Major concerns raised by those who attended the meeting were: impacts of cleanup and storage on property values; justification for temporary storage; health risks from the cleanup; risks from transporting material to the site; and concerns that the temporary storage facility would become permanent if the State fails to assure the availability of a permanent disposal site.

The comment period on the second draft Card Corporation Operable Unit X Feasibility Study was from April 27 through May 15, 1987. During this comment period, the EPA held several availability sessions where concerned citizens could speak one-on-one with EPA representatives. A second public meeting was held on May 7, 1987. Issues raised during this meeting and the availability

sessions were similar to those expressed during the first public meeting. The Community Relations Responsiveness Summary attached to the ROD describes in more detail the nature and level of the community's concern and includes EPA's response to all comments received during the public review of both the first and second draft Card Corporation Operable Unit X Feasibility Study.

Future Actions

The future remedial activities that are required to complete remedial action at the Card property are:

(1) Negotiate final administrative order with Mentor Corporation.

(2) Design remedial action and temporary storage facility.

(3) Enter into State Superfund Contract with State of Colorado.

(4) Conduct remedial action for contamination present on Card property.

(5) Determine via RODs on remaining Denver Radium Site Operable Units if material from certain other Denver Radium Site properties will be temporarily stored and staged at the Card property.

(6) Select and, if necessary, design and construct permanent disposal facility. (This activity is to be conducted by State of Colorado.)

(7) Remove contaminated material from Card property to permanent disposal facility.

(8) Decontaminate and demolish temporary storage facility and dispose of material in a sanitary landfill.

Schedule

Dates for completing key milestones leading to remedial action at the Card property are highlighted below.

(1) Complete design of remedial action and temporary storage facility by April 1, 1988

(2) Complete negotiations on administrative order with Mentor Corporation by August 1, 1987

(3) Finalize State Superfund Contract with State of Colorado by April 1, 1988

(4) Initiate remedial action no later than during third quarter fiscal year 1988

ATTENTION

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